into maltose. The validity of the observations upon which is based Nägeli's hypothesis as to the growth and structure of starch grains is denied in toto. The grains have their origin and growth entirely within chromatophores where they are held as long as the cell is living. Growth consists of the superposition of new layers of material on those previously formed. The layers or coats are due to the periodic activity of the chromatophore. The contour of the grains is due entirely to the pressure exerted on the chromatophore by the cytoplasm, and the size depends upon the biologic relations of the plant. Thus in rapidly germinating seeds or in other structures where rapid solution of reserve material is desirable, the grains are small, and easily fissured. The granula of the chloroplasts are regarded as the organs of synthesis of the carbohydrates, and the stroma as the organ of formation of starch material and diastase. In the consideration of the morphology of the chromatophore the author is led to conclusions in harmony with Berthold's theory of the emulsion structure of protoplasm. In a series of monographs which form an appendix to the chief thesis, he describes the results of his researches on the seasonal periodicity and other biologic relations of the starch grains of Dieffenbachia seguina, Pellionia daveauana, Hyacinthus orientalis, Cyrtodeira cupreata, Adoxa moschatellina, and Hordeum distichum. The book contains all of the author's work upon starch, much of which has been previously published. It is well illustrated and logically arranged. The great number of macro- and micro-chemical reactions given makes the work invaluable in the laboratory. With this work at hand the archaic views as to the composition, structure, and growth of starch grains which find place in the best botanical as well as chemical text books will no longer be excusable.—D. T. MAC DOUGAL.

Arctic and Alpine plants.[1]

The present paper by Bonnier points out the difference in structural development of some arctic plants as compared with the same species collected in the Alps and Pyrenees. The arctic plants were collected by Charles Rabot, who visited Jan Mayen and Spitzbergen in the summer of 1892. We must note, however, that since these plants were col-

[1]Gaston Bonnier: Les plantes arctiques comparées aux mêmes espèces des Alpes et des Pyrénées. Revue gén. de Botanique **6**: 505–527. *pl. 4.* 1894.

lected on the shore of these islands where heavy fogs prevail during the summer we do not get a complete illustration of the anatomy of the arctic plants. The climatic conditions vary greatly in the polar regions, and there are certainly many places, where the summer has sunny days with clear sky, at least during the months of June and July. The paper is nevertheless very interesting and we record some of the most important results. Oxyria digyna, Saxifraga oppositifolia, Salix reticulata, Silene acaulis, Cerastium alpinum, Potentilla nivea and Poa pratensis are described anatomically, and a few other species are briefly discussed. The anatomical examination comprises the leaf, the stem, the inflorescences and the root, and the accompanying plates contain several good figures showing the habit of some of these species and their anatomical structure. As compared with their alpine representatives the following modifications are observable as characteristic of arctic species:

1. The lignified elements are reduced in number; their cell-walls are less thick and the lumen of the vessels much narrower than in the alpine plants.

2. The leaves are thicker but less differentiated; the palisade tissue is less pronounced; the intercellular spaces are more developed.

3. The epidermis of the stem and leaves is less coherent and the cuticle less thick.

4. The cells of the various tissues of the stem, the leaves and the root show a tendency to a roundish outline; some of the cells often develop like trabeculæ, and these separate large intercellular spaces.

The author believes that the causes of these anatomical modifications are especially the atmospheric humidity and the character of the light. The most important factor is, of course, the light of the midnight-sun which is continuous in the summer months, but not so intense as the light in the Alps. The humidity of the soil and the temperature do not seem to cause any modifications of importance, at least not in the plants examined.—THEO. HOLM.